ICCGE-17 ABSTRACT

Stability of Menisci in Detached Bridgman Growth

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Abstract

Detached growth, also referred to as dewetted growth, is a Bridgman crystal growth process in which the melt is in contact with the crucible wall but the crystal is not. A meniscus bridges the gap between the top of the crystal and the crucible wall. The meniscus shape depends on the contact angle of the melt with the crucible wall, the growth angle of the melt with respect to the solidifying crystal, the gas pressure differential, the Weber number describing the rotation rate of the crucible, and the Bond number. Only some of the meniscus shapes are stable and the stability criterion is the sign of the second variation of the potential energy upon admissible meniscus shape perturbations. The effects of confined gas volumes above and below the melt and crucible rotation are evaluated. The analysis is applicable to the non-stationary case where the crystal radius changes during growth. Static stability maps (crystal radius versus pressure differential) are obtained for a series of Bond numbers, growth angles and Weber numbers. Also, the specific cases of Ge and InSb, in both terrestrial and microgravity conditions, are analyzed. Stability was found to depend significantly on whether the interior surface was considered to be microscopically rough or smooth, corresponding to pinned or unpinned states. It was also found that all meniscus shapes are statically stable in a microgravity environment.